

this objection, and that suggested wording has been adopted in this amendment.

Claims 2, 3, 6, 9 and 13-17 are rejected under 35 U.S.C. §112, second paragraph, as allegedly being indefinite for failing to particularly point out and distinctly claim the subject matter which applicant regards as the invention.

The Examiner objects to the phrase "said major scanning direction" in claim 9, to the phrase "almost perpendicular" in claim 2 and to the phrases "almost in parallel" and "almost perpendicular" in claim 3. Claim 9 is amended to recite "said main scanning direction", while claim 2 is amended to recite "substantially perpendicular". Claim 3 is amended to employ the word "substantially" rather than "almost". In view of these amendments, it is respectfully requested that the 35 U.S.C. §112, second paragraph rejection be reconsidered and withdrawn.

Applicant has adopted and again thanks the Examiner for providing suggested wording to resolve the Examiner's concerns.

Claims 1-5, 7, 8 and 10-15 are rejected under 35 U.S.C. §103(a) as allegedly being unpatentable over Cobbs et al (U.S. 5,600,360) in view of Goetz et al (U.S. 5,170,416). Applicant respectfully traverse the rejection.

Goetz et al disclose counters (86 and 88) for accumulating a count proportional to the length of time between the positive edges of successive opaque regions of an encoder scale (see column 4, lines 43-45 of Goetz et al). However, this is not for obtaining a high-resolution position to be combined with a low-resolution position as in applicant's claimed invention, but is

just for correcting duty-cycle errors generated by imperfections in encoder scales and encoder detectors (see column 3, lines 15-17 of Goetz et al). Thus, Goetz et al can correct the duty-cycle errors of a low-resolution position detector but fail to provide a high-resolution position detection which allows the detection of the individual small pitch positions between adjacent pulses of the linear scale. Thus, combining Cobbs et al with Goetz et al does not produce applicant's claimed invention as set forth in claims 1-5, 7, 8 and 10-15. It is respectfully submitted that claims 1-5, 7, 8 and 10-15 are therefore allowable.

Claims 6 and 16 are rejected under 35 U.S.C. §103(a) as allegedly being unpatentable over Cobbs et al in view of Goetz et al as applied to claim 2 above, and further in view of Gast et al, U.S. 6,367,903. Applicant respectfully traverses this rejection.

The Examiner indicates that Gast et al "discloses a vertical bar that is printed by different portions of a single head and detecting the vertical bar in two positions to establish a print position based on the average value of the detected positions (figure 3, figure 15a, figure 15b, figure 25, column 3, lines 35-46)". Applicant respectfully submits that the Examiner is misinterpreting or misunderstanding what is taught by Gast et al. The vertical bar shown in Figure 25 is a test pattern printed using seven scans. This might seem, at first glance, to be similar to the vertical bar recited in applicant's claims 6 and 16. However, it is not. Each row of the seven rows in Gast et al is a separate test pattern to be sensed by a separate scan.

This will be apparent from the fact that the single-row test pattern shown in Figure 10 is a separate test pattern which corresponds to each row of the seven rows of the test pattern shown in Figure 25. Therefore, the test pattern shown in Figure 25 of Gast et al is completely different from such a vertical bar as recited in Applicant's claims 6 and 16. Therefore, the combination proposed by the Examiner, does not teach or suggest the claimed invention of claims 6 and 16. It is respectfully submitted that claims 6 and 16 are therefore allowable.

Claims 9 and 17 are rejected under 35 U.S.C. §103(a) as allegedly being unpatentable over Cobbs et al in view of Gast et al. Applicant respectfully traverses this rejection.

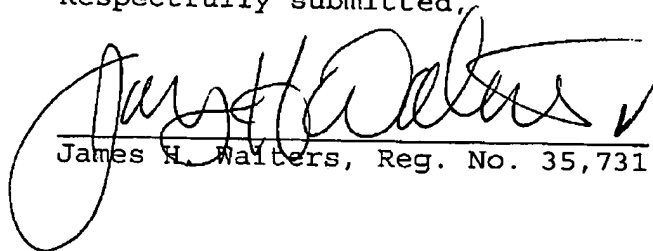
As noted above in connection with claims 6 and 16, the vertical bar shown in Figure 25 of Gast et al is a test pattern printed using seven scans. While this might seem, at first glance, to be similar to the vertical bar recited in applicant's claims 9 and 17, it is not. Each row of the seven rows in Gast et al is a separate test pattern to be sensed by a separate scan. This will be apparent from the fact that the single-row test pattern shown in Figure 10 is a separate test pattern which corresponds to each row of the seven rows of the test pattern shown in Figure 25. Therefore, the test pattern shown in Figure 25 of Gast et al is completely different from such a vertical bar as recited in Applicant's claims 6 and 16. Therefore, the combination proposed by the Examiner, does not teach or suggest the claimed invention of claims 9 and 17. It is respectfully submitted that claims 9 and 17 are therefore allowable.

The other additional prior art noted by the Examiner has been reviewed and is not believed to affect the patentability of applicant's claims.

No amendment made was related to the statutory requirements of patentability unless expressly stated herein. No amendment made was for the purpose of narrowing the scope of any claim, unless applicant has argued herein that such amendment was made to distinguish over a particular reference or combination of references.

In light of the above noted amendments and remarks, this application is believed in condition for allowance and notice thereof is respectfully solicited. The Examiner is asked to contact applicant's attorney at 503-224-0115 if there are any questions.

Respectfully submitted,

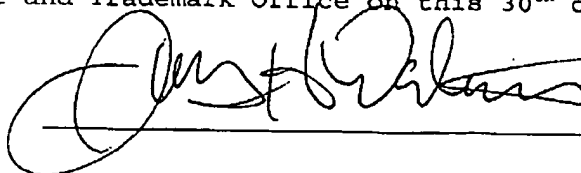


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MARKUP VERSION TO SHOW CHANGES MADE

1. (Amended) An image forming device that forms an image on a print paper in an ink jet recording method with a plurality of heads, comprising:

main scanning direction moving means for moving a carriage in a main scanning direction, said carriage having said plurality of heads mounted thereon;

paper conveying means for conveying the print paper in a sub-scanning direction;

pattern printing means for printing, with at least one head, a test pattern including predetermined pattern elements;

pattern detecting means, mounted on said carriage, for detecting the pattern elements of the test pattern printed on the print paper by said printing means;

binary conversion means for binarizing an output of said pattern detecting means;

position detecting means for detecting a position of the carriage in said main scanning direction; and

calculating means for moving said carriage to detect the pattern elements of the test pattern with said pattern detecting means, for detecting a print position of the pattern elements based on a detection result of said position detecting means when a rising and/or falling edge of a binary signal obtained by said binary conversion means is generated, and for calculating a mounting deviation amount of each head in said [major] main scanning direction,

wherein said position detecting means comprises low-resolution position detecting means based on a linear scale provided on a movement path of said carriage and high-resolution position detecting means for detecting a position more finely than a minimum unit determined by a resolution of said low-resolution position detecting means such that said low-resolution position detecting means and said high resolution position detection means are combined with each other to precisely detect the positions of the pattern elements.

2. (Amended) The image forming device according to claim 1 wherein, for each head, said test pattern is at least one vertical bar extending in the sub-scanning direction [almost] substantially perpendicular to said main scanning direction.

3. (Amended) The image forming device according to claim 1, wherein said test pattern includes, for each head and as a pattern element, at least one horizontal bar extending [almost] substantially in parallel with said main scanning direction, further comprising:

conveyance amount detecting means for detecting a conveyance amount of the print paper in the sub-scanning direction [almost] substantially perpendicular to said main scanning direction; and

measuring means for measuring the conveyance amount equal to or smaller than a minimum unit determined by a resolution of said conveyance amount detecting means,

wherein said calculating means moves the print paper, on which the test pattern is printed, with the use of said paper

conveying means with respect to the carriage to detect the pattern elements of the test pattern with said pattern detecting means, detects the print position of the pattern elements based on the detection results of said conveyance amount detecting means and said measuring means when a rising and/or falling edge of the binary signal obtained by said binary conversion means is generated, and calculates an amount of mounting deviation of each head in said sub-scanning direction based on the print position of the pattern elements printed by each head.

7. (Twice Amended) The image forming device according to claim 1 wherein said calculating means uses said pattern detecting means to detect the vertical bar in at least two positions in a longitudinal direction of said vertical bar to obtain a print position of said vertical bar based on an average value of the detected results.

9. (Amended) An image forming device that forms an image on a print paper in an ink jet recording method with a plurality of heads, comprising:

main scanning direction moving means for moving a carriage in a main scanning direction, said carriage having said plurality of heads mounted thereon;

paper conveying means for conveying the print paper in a sub-scanning direction;

pattern printing means for printing, with at least one head, a test pattern including predetermined pattern elements;

pattern detecting means, mounted on said carriage, for detecting the pattern elements of the test pattern printed on the print paper by said printing means;

binary conversion means for binarizing an output of said pattern detecting means;

position detecting means for detecting a position of the carriage in said main scanning direction; and

calculating means for moving said carriage to detect the pattern elements of the test pattern with said pattern detecting means, for detecting a print position of the pattern elements based on a detection result of said position detecting means when a rising and/or falling edge of a binary signal obtained by said binary conversion means is generated, and for calculating a mounting deviation amount of each head in said [major] main scanning direction,

wherein, for each head, said test pattern includes as a pattern element at least one vertical bar extending in the sub-scanning direction [almost] substantially perpendicular to said main scanning direction, and

wherein said pattern printing means divides said vertical bar into a plurality of portions and causes each of different portions of a single head to print a plurality of dots sequentially in a plurality of passes, said plurality of dots constituting a portion of said vertical bar.

11. (Amended) A method, for use on an image forming device with a linear scale provided on a carriage movement path, for

detecting a deviation between a print position actually printed on a print paper by a head and a print target position, said method comprising the steps of:

providing a timer for detecting a position within a unit interval determined by a resolution of said linear scale;

printing a predetermined print element at the target position on the print paper by the head mounted on a carriage that scans in a [major] main scanning direction;

detecting said print element with a sensor mounted on said carriage; [and]

detecting a low-resolution position based on said linear scale when the print element is detected and, detecting a high-resolution position within the unit interval with said timer, by combining said low-resolution position with said high-resolution position; and

obtaining the deviation between the detected position and said print target position.

16. (Amended) The image forming device according to claim 6 wherein said calculating means uses said pattern detecting means to detect the vertical bar in at least two positions in a longitudinal direction of said vertical bar to obtain a print position of said vertical bar based on an average value of the detected results.